

WE CLAIM:

1. A composite sheet comprised of:
  - a) a base layer of reinforcing fibers impregnated with a thermoplastic resin;
  - b) a mat adjacent to the layer wherein the mat is made of a non-woven fiber;
  - c) wherein the non-woven fiber mat is partially impregnated with the thermoplastic resin of the base layer thereby creating a mechanical bond between the base layer and the mat thereby providing a bondable surface with the non-impregnated surface of the non-woven fiber; and
  - d) wherein the thermoplastic has a melting point less than the melting point of the reinforcing fibers in the base layer and less than the melting point of the non-woven fiber mat.
2. The composite sheet according to claim 1 wherein between 25-75% of the non-woven fiber is impregnated with thermoplastic resin from the base layer.
3. The composite sheet according to claim 1 wherein the thermoplastic resin is a thermoplastic resin selected from the group consisting of ABS, nylon, polyester, polyolefin, polypropylene, PVC and polystyrene.
4. The composite according to claim 1 wherein the non-woven fiber of the mat is a fiber selected from the group consisting of fiberglass, polyester, and nylon.
5. The composite sheet according to claim 1 wherein the reinforcing fibers are from the group consisting of woven and non-woven fibers.
6. The composite sheet according to claim 1 wherein the fiber in the base layer is fiber having a pattern from the group consisting of woven mat, chopped mat, random mat and randomly scattered fibers.

7. The composite sheet according to claim 1 wherein the fiber in the base layer may contain either continuous or discontinuous fibers.

8. The composite sheet according to claim 1 wherein the non-woven fiber is manufactured by a technique selected from the group consisting of spunbond, point bond, flat bond and needle punch.

9. The composite sheet according to claim 1 wherein the fiber in the base layer is a fiber selected from the group consisting of fiberglass, carbon, natural fibers aramide, nylon, and polyolefin.

10. The composite sheet according to claim 9 wherein the natural fibers are selected from the group consisting of flax, cellulose and wood.

11. The composite sheet according to claim 1 wherein the reinforcing fibers and thermoplastic resin are one pair from the group of pairs consisting of fiberglass/polypropylene thermoplastic resin, carbon fiber/polypropylene thermoplastic resin, aramide fibers/nylon thermoplastic resin, polyolefin fibers/polyolefin thermoplastic resin, and polyester fibers/polypropylene thermoplastic resin.

12. The composite sheet according to claim 1 wherein the non woven fibers are comprised of fiberglass and have an overall density of between 1.5 oz/sq yd. to 6.0 oz/sq yd.

13. The composite sheet according to claim 1 wherein the non-woven fibers are polyester or organic fibers and have an overall density of between 0.75 oz/sq yd. to 3.0 oz/sq yd.

14. A method for bonding a non-woven fiber mat to a base layer of reinforcing fibers using thermoplastic resin to form a composite sheet, wherein the method comprises the steps of:

a) providing an impregnated base layer having reinforcing fibers with thermoplastic resin impregnated therein;

b) partially impregnating the non-woven fiber mat with the thermoplastic resin thereby mechanically bonding one side of the non-woven fiber mat to the thermoplastic resin impregnated within the base layer and forming a composite sheet having a mechanically bondable surface on the other side of the non-woven fiber mat; wherein the thermoplastic resin has a melting point of less than the melting point of the reinforcing fibers in the base layer and less than the melting point of the non-woven fiber mat.

15. The method according to claim 14 wherein the step of providing an impregnated base layer comprises utilizing a pre-existing impregnated base layer with thermoplastic resin impregnated therein.

16. The method according to claim 14 wherein the step of providing an impregnated base layer comprises heating the a non-consolidated thermoplastic resin and compressing the thermoplastic resin against the reinforcing fibers of the base layer.

17. The method according to claim 16 wherein the thermoplastic resin is heated before the compression of the thermoplastic resin against the reinforcing fibers of the base layer.

18. The method according to claim 16 wherein the thermoplastic resin is heated during the compression of the thermoplastic resin against the reinforcing fibers of the base layer.

19. The method according to claim 16 further including, after the step of compressing the thermoplastic resin against the reinforcing fibers of the base layer to form an impregnated base layer, the step of cooling the impregnated base layer to a temperature below the melting point of the thermoplastic resin.

20. The method according to claim 16 wherein the fibers of the base layer prior to heating is in the form of one from the group consisting woven, continuous, discontinuous, chopped and random fibers.

21. The method according to claim 20 wherein the fibers of the base layer prior to heating are chopped fibers and dispersed upon a carrier belt.

22. The method according to claim 16 wherein the thermoplastic resin prior to heating is in the form of one from the group consisting of sheet, pellets and particles.

23. The method according to claim 22 wherein the thermoplastic resin is in the form of one from the group consisting of fibers, pellets or particles and prior to heating are dispersed randomly on a carrier belt.

24. The method according to claim 16 wherein, prior to heating, the thermoplastic resin and the reinforcing fibers of the base layer are both in the form of thread commingled to form a sheet.

25. The method according to claim 14 wherein the step of providing an impregnated base layer and the step of partially impregnating the woven fiber mat occur simultaneously.

26. The method according to claim 25 wherein the thermoplastic resin is heated and compressed simultaneously between the base layer of reinforcing fiber and the non-woven fiber mat such that the base layer is fully impregnated and the non-woven fiber mat is partially impregnated.

27. The method according to claim 25 wherein the thermoplastic resin prior to heating is in the form of one from the group consisting of sheet, pellets and particles.

28. The method according to claim 27 wherein the thermoplastic resin is in the form of one from the group consisting of fibers, pellets or particles and prior to heating are dispersed randomly on a carrier belt.

29. The method according to claim 25 wherein the fibers of the base layer prior to heating are in the form of one from the group consisting of woven, continuous, discontinuous, chopped, and random fibers.

30. The method according to claim 29 wherein the fibers of the base layer prior to heating are chopped fibers and prior to heating are dispersed upon a carrier belt.

31. The method according to claim 25 wherein the fibers of the non-woven fiber layer prior to heating are in the form of one from the group consisting of discontinuous, chopped, and random fibers.

32. The method according to claim 31 wherein the fibers of the base layer prior to heating are chopped fibers and prior to heating are dispersed upon a carrier belt.

33. The method according to claim 25 wherein, prior to heating, the thermoplastic resin and the reinforcing fibers of the base layer are both in the form of thread commingled to form a sheet.

34. The method according to claim 25 further including the step, after the step of impregnating both the reinforcing fibers of the base layer and the non-woven fibers of the mat, of cooling the thermoplastic resin.

35. The method according to claim 25 wherein the thermoplastic resin is heated before the compression of reinforcing fibers of the base layer and the non-woven fiber of the mat with the thermoplastic resin.

36. The method according to claim 25 wherein the thermoplastic resin is heated during the compression reinforcing fibers of the base layer and the non-woven fiber of the mat with the thermoplastic resin.

37. The method according to claim 14 wherein the step of partially impregnating the non-woven fiber mat comprises heating the impregnated base layer and compressing the impregnated base layer against the non-woven fiber mat.



38. The method according to claim 37 wherein the thermoplastic resin is heated before the compression between the base layer of reinforcing fiber and the non-woven fiber of the mat with the thermoplastic resin impregnated within the reinforcing fibers of the base layer.

39. The method according to claim 37 wherein the thermoplastic resin is heated during the compression between the reinforcing fibers of the base layer and the non-woven fiber of the mat.

40. The method according to claim 37 further including, after the step of partially impregnating the non-woven fiber mat, the step of cooling the partially impregnated mat to a temperature below the melting point of the thermoplastic resin.

41. The method according to claim 37 wherein the mat prior to heating is in the form of one from the group consisting of sheet, pellets and particles.

42. The method according to claim 14 wherein the thermoplastic is heated by applying heat to the exposed sides of the base layer of reinforcing fiber and the non-woven fiber mat and wherein the sides are heated to the same temperature for impregnation.

43. The method according to claim 14 wherein the thermoplastic is heated by applying heat to the exposed sides of the base layer of reinforcing fiber and the non-woven fiber mat and wherein the base layer side is heated to a greater temperature than the non-woven fiber mat side to control the depth to which the thermoplastic resin impregnates the non-woven fiber mat.

44. The method according to claim 14 wherein the thermoplastic is heated by at least one from the group comprised of convection, conduction and radiation.

45. A method of partially impregnating a non-woven fiber mat with a thermoplastic resin attached to a base layer of reinforcing fibers to create composite sheet having a bondable surface comprising the steps of:

a) heating the thermoplastic resin to at least the temperature of the melting point and compressing the resin against the base layer of reinforcing fibers to produce a fully impregnated base layer;

b) compressing the impregnated base layer against the non-woven fiber mat;

c) heating the impregnated base layer sheet and the non-woven fiber mat to at least the temperature of the melting point of the thermoplastic resin but below the melting point of the non-woven fiber mat and compressing the impregnated base layer against the non-woven mat until the thermoplastic resin partially impregnates the non-woven fiber mat to produce a composite sheet; and

d) cooling the composite sheet;

e) wherein the melting point of the thermoplastic resin is less than the melting point of either the reinforcing fibers of the base layer or the non-woven fiber of the mat.

46. A method of partially impregnating a non-woven fiber mat with a thermoplastic resin attached to a base layer of reinforcing fibers to create composite sheet having a bondable surface comprising the steps of:

a) compressing the base layer of reinforcing fibers impregnated with thermoplastic resin against the non-woven fiber mat;

b) heating the base layer sheet and the non-woven fiber mat to a temperature above the melting point of the thermoplastic resin but below the melting point of the non-woven fiber mat until the thermoplastic resin partially impregnates the non-woven fiber mat to produce a composite sheet; and

c) cooling the composite sheet;

d) wherein the melting point of the thermoplastic resin is less than the melting point of either the reinforcing fibers of the base layer or the non-woven fiber of the mat.

47. A method of partially impregnating a non-woven fiber mat with a thermoplastic resin attached to a base layer of reinforcing fibers to create composite sheet having a bondable surface comprising the steps of:

a) compressing the thermoplastic resin between a non-consolidated base layer of reinforcing fiber and a non-woven fiber mat to form a composite arrangement; and

b) heating the arrangement to a temperature above the melting point of the thermoplastic resin but below the temperature of either the base layer of reinforcing fiber or the non-woven fiber mat such that the thermoplastic sheet completely impregnates the reinforcing fiber of the base layer and partially impregnates the non-woven fiber of the mat to form a composite sheet; and

c) cooling the composite sheet;

d) wherein the melting point of the thermoplastic resin is less than the melting point of either the reinforcing fibers of the base layer or the non-woven fiber of the mat.

48. A composite sheet having at least one side with a mechanically bondable face, where the composite sheet is produced by a method comprising the steps of:

a) providing a base layer of reinforcing fiber impregnated with a thermoplastic resin and

b) partially impregnating a non-woven fiber of mat with the thermoplastic resin from the impregnated base layer thereby mechanically bonding one side of the non-woven fiber to the woven fiber and forming a composite sheet having a mechanically bondable surface on the other side of the non-woven fiber.